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GB 2186240 A GB 1228088 A EP 0546352 A1
US 5080410 A US 4909465 A

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INT CL^6 B60R 19/24 19/26 19/34 , B62D 21/15
Online: WPI

(54) Side frame extension structure for a vehicle

(57) A vehicle structure includes left and right extension members 3 attached to vehicle side frames (2 figure 1) and a bumper face (4 figure 1) covering the distal ends of said extension members, characterised in that the extension members are each formed from a tubular member made up of a first segment 11 and a second segment 16 joined one above the other. The distal end of the second segment may be either spaced rearwardly from or aligned vertically with the distal end of the first segment (figures 4 and 6). The distal end of the first segment may be slanted at an acute angle and may have a flange 14. The second segment may have a pair of flanges (18 figure 7) formed at its distal end. The extension members may have a tapered form, being smaller in height at the distal end than the proximal end. The side frame extensions serve to absorb the energy of a collision.

FIG.2

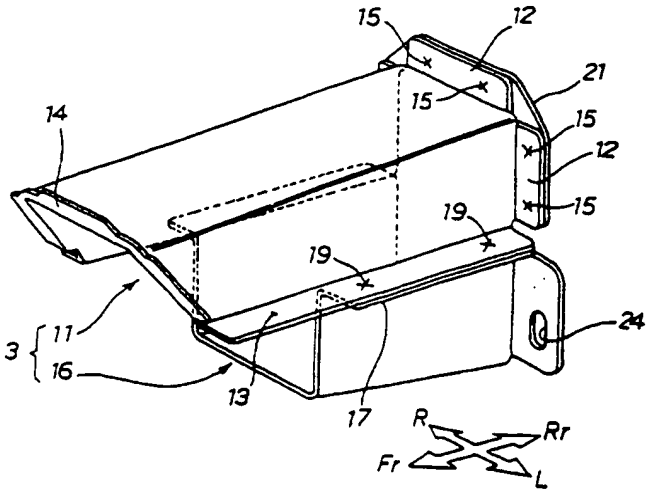

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FIG.1

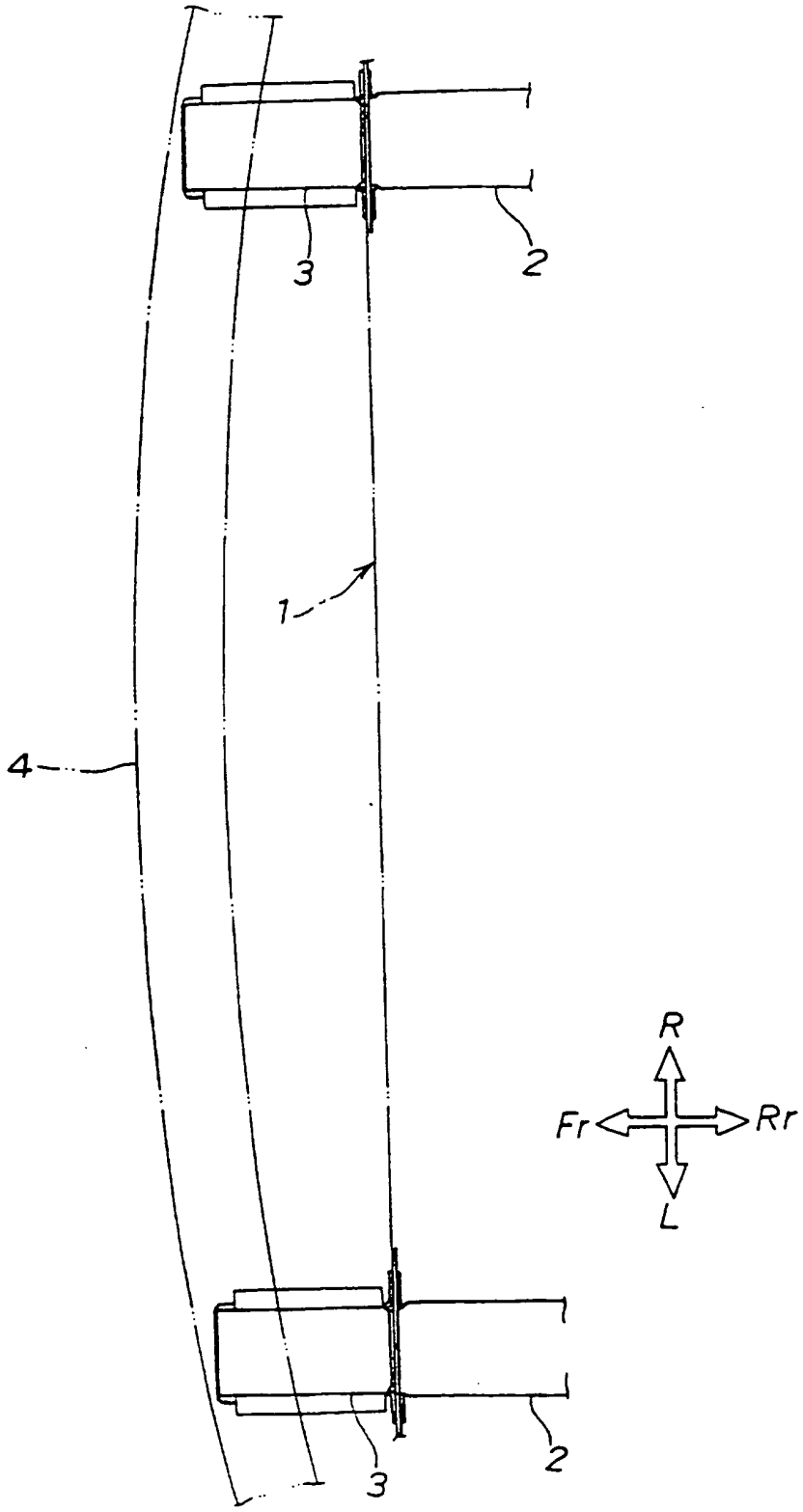


FIG. 2

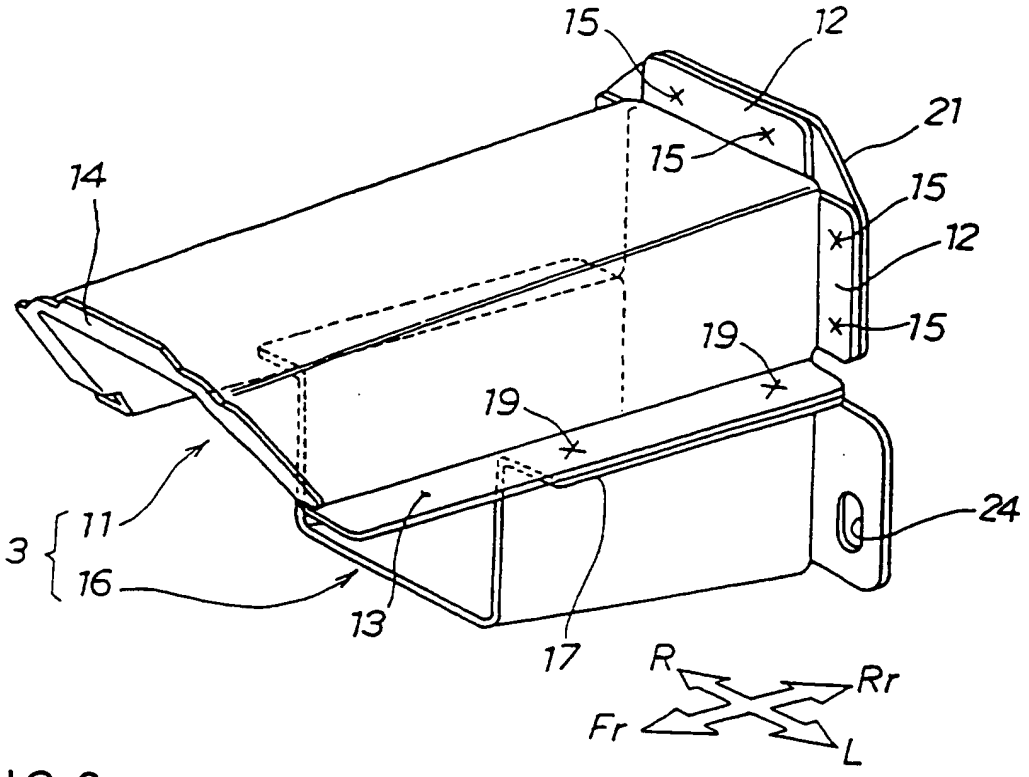
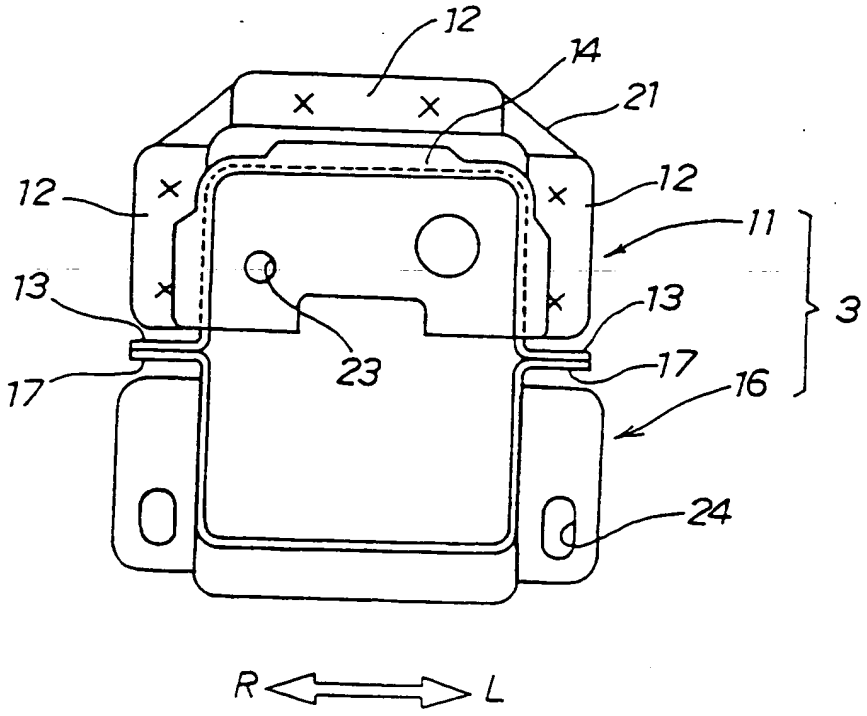

15
12
21
15
14
15
12
15
19
19
3
11
16
13
17
24
R
Rr
Fr
L

FIG. 3


12
14
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3
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17
16
24
R
L

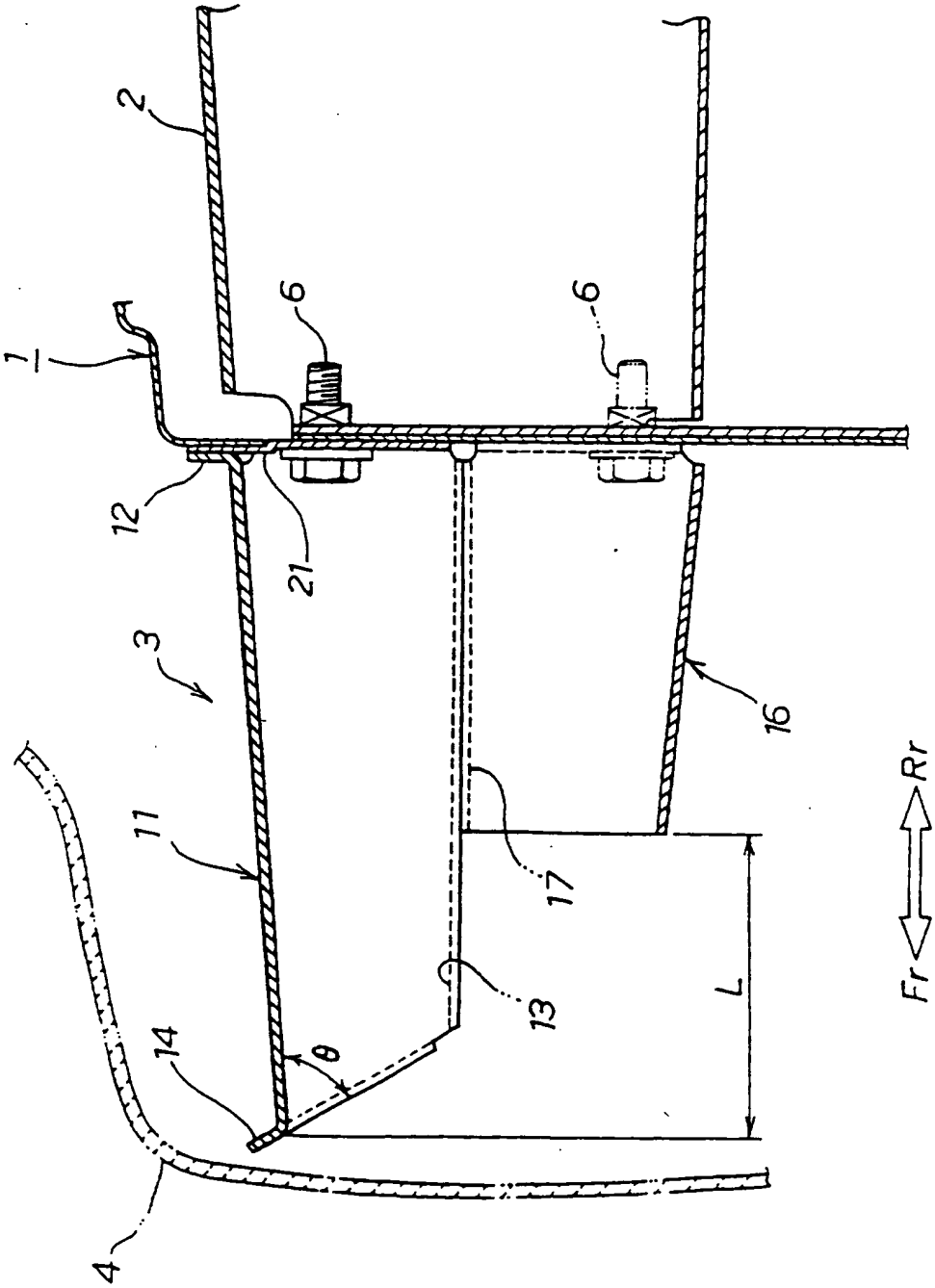


FIG.4

FIG.5A

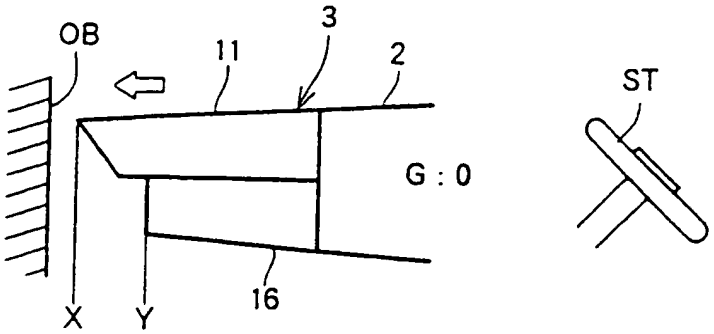


FIG.5B

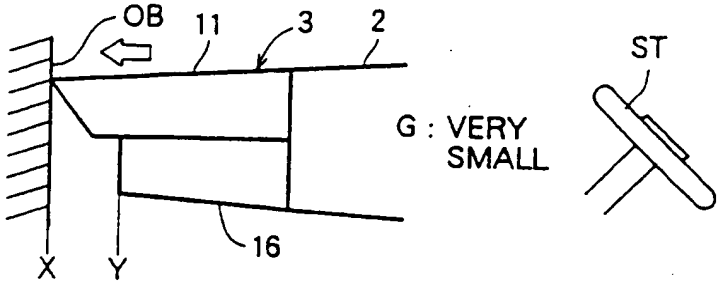


FIG.5C

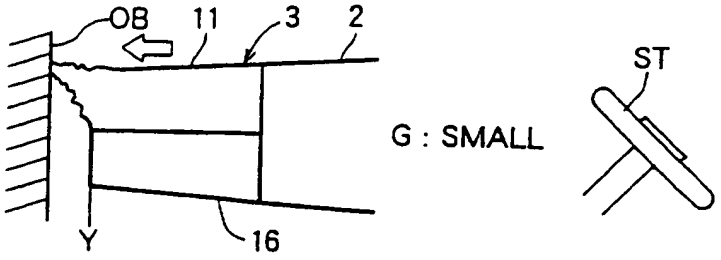


FIG.5D

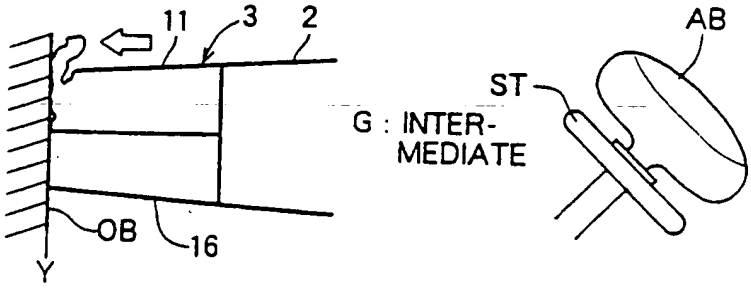
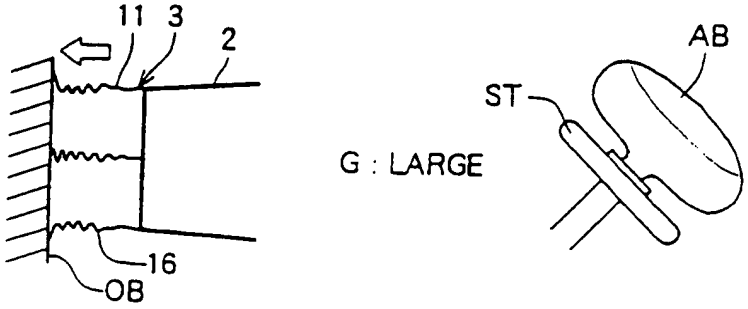


FIG.5E



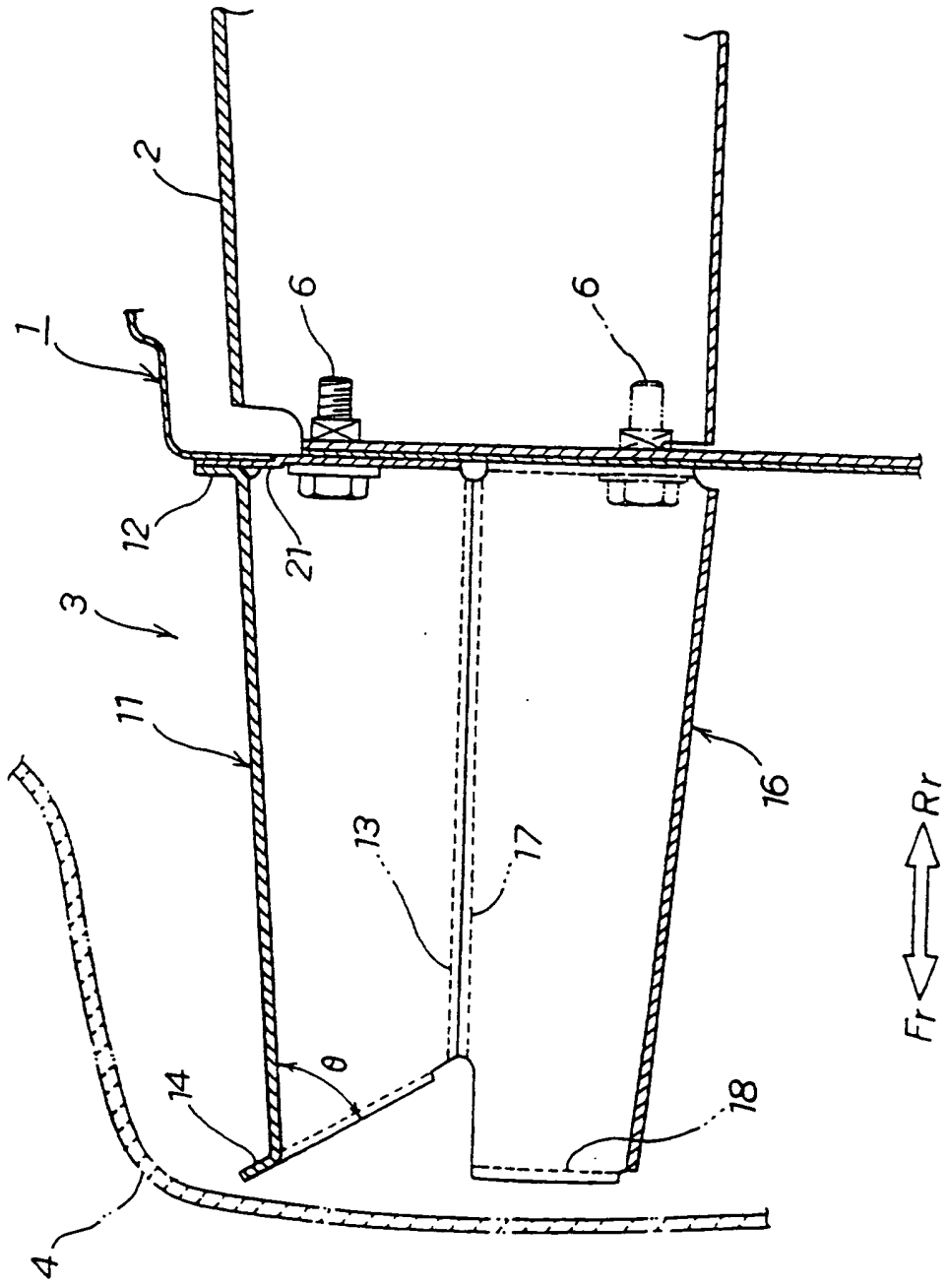


FIG.6

FIG. 7

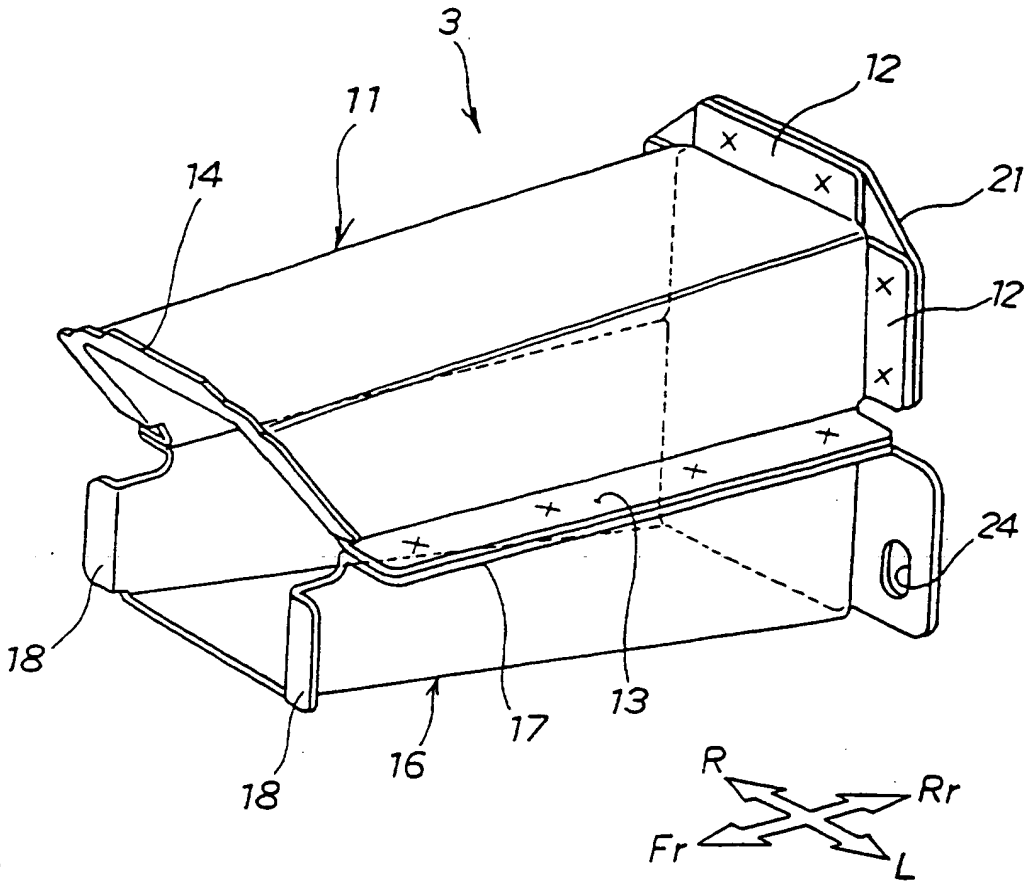


FIG.8
(PRIOR ART)

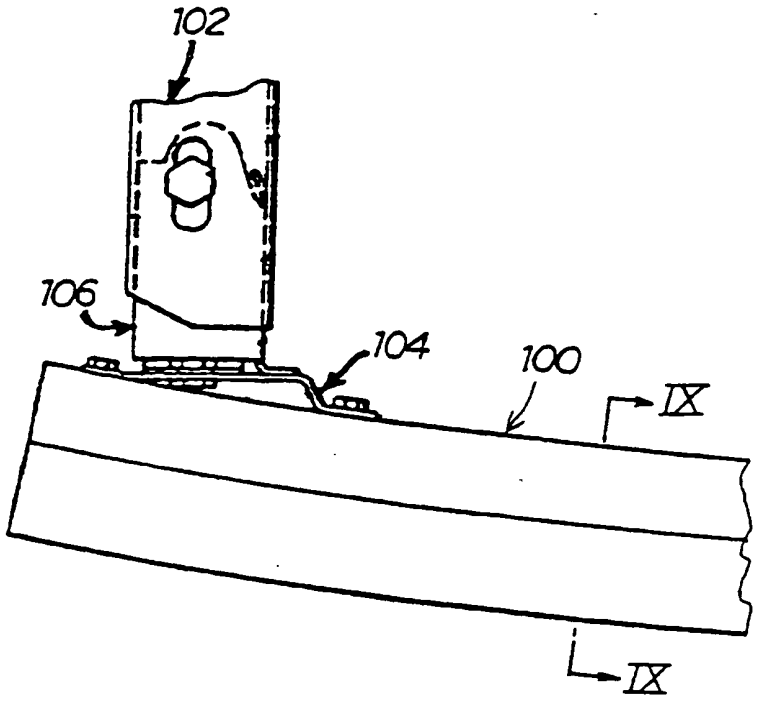
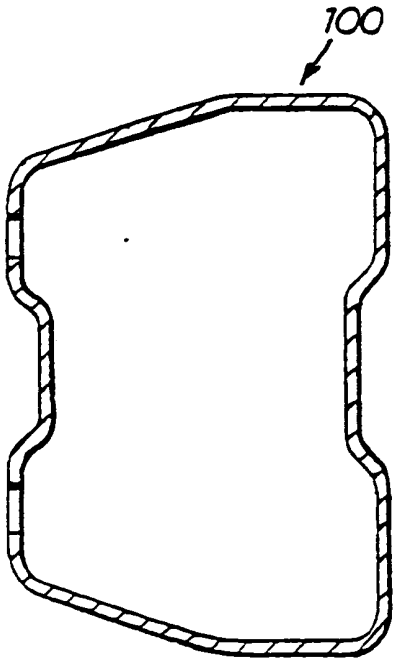


FIG.9
(PRIOR ART)



SIDE FRAME STRUCTURE FOR VEHICLES

The present invention relates to a side frame structure for vehicles of the type including side frame extension members attached to the front ends of side frames of a vehicle body.

Various bumper mounting structures are known in which a bumper beam extending in the direction of the width of a vehicle body (hereinafter referred to as "vehicle width direction") and covered with a bumper face is attached to a front section of the vehicle body via a support.

One known bumper mounting structure is disclosed, for example, in U.S. Patent No. 5,080,410 calling for a "Bumper Beam for Vehicles". The disclosed vehicle bumper beam is schematically shown in FIGS. 8 and 9 hereof.

As shown in FIGS. 8 and 9, the bumper beam 100 has a box-shaped hollow structure formed from a high-strength steel and is attached to the front face of a vehicle body via side rails 102 (corresponding to a support). More specifically, the bumper beam 100 is bolted at its rear surface to each of the side rails 102 via a first bracket 104 and a second bracket 106, as shown in FIG. 8.

In recent years, many cars or vehicles are equipped with an air bag system. It is essential for such vehicles that an appropriate magnitude of collision energy to be detected by the air bag system for activation thereof is set with sufficient reliability.

To deal with this requirement, it may be considered that side frame extension members are attached to the front ends of left and right side frames extending longitudinally of the vehicle body, with respective front end portions of the side frame extension members covered by a bumper face extending in the vehicle width direction. The side frame extension members (including the side rails 102) double in function as means for absorbing the energy of a crash or collision and as means for setting an adequate magnitude of collision energy to be detected by the air bag system.

The side frame extension members designed to hold two functions at one time are liable to be complicated in construction. In addition, since the side frame extension members should be replaced with ones of a totally different construction depending on the presence of the air bag system, production of two different types of side frame extension members becomes necessary. This will considerably lower the productivity of the side frame extension members and requires a complicated parts control system.

According to the present invention there is provided a side frame structure for a vehicle including left and right side frames extending in the longitudinal direction of a vehicle body, left and right side frame extension members attached to the respective front ends of said side frames, and a bumper face extending in the direction of the width of said vehicle body so as to cover distal end portions of said

side frame extension members, characterized in that said side frame extension members are each composed of a tubular member formed by a first segment and a second segment joined together one above the other.

When used in a vehicle equipped with an air bag system, a front end (distal end) of the second segment may be offset or displaced rearwardly from a front end (distal end) of the first segment. With this arrangement, there is provided a distinguishable difference between the magnitude of a collision energy needed to plastically deform or otherwise crush the first and second segments concurrently. This makes it possible to set, with sufficient reliability, an adequate magnitude of collision energy to be detected by the air bag system for activation of the same. The first segment projecting from the front end of the second segment serves to absorb a certain amount of collision energy.

For a vehicle not equipped with an air bag system, the first

and second segments having substantially the same length are used. In this instance, since the first and second segments are concurrently engaged in absorbing the collision energy, a much greater collision energy can be absorbed by the side frame extension member.

The side frame extension member is simple in construction but the construction can be changed by merely changing the position of the front end of the second segment relative to the front end of the first segment. The side frame extension member thus constructed can be attached to various types of vehicles. In addition, since the first segment is used in common regardless of the application of the side frame extension member, an enhanced effect of mass production and an easy parts control system are available. This will provide a considerable reduction in production cost of the side frame extension member.

In one preferred form of the invention, the front end of the second segment is offset or spaced rearwardly from the front end of the first segment, so that a collision force or energy acts first on the first segment and, when the first segment is permanently deformed to a certain extent, it acts on the second segment. With this two-stage transmission of collision energy, there is provided a clear difference between a small collision energy just enough to cause permanent deformation of the first segment, and a large collision energy sufficient to cause permanent deformation of the first and second segments. The

difference in collision energy is used to set an adequate magnitude of collision energy to be detected by the air bag system for activating the same. The side frame extension member is capable of absorbing collision forces or energies ranging from a small collision energy that can be absorbed solely by the first segment, to a large collision energy that can be absorbed jointly by the first segment and the second segment.

According to a preferred form of the invention, the first segment has an acute front end portion. The first segment having such acute front end portion can be deformed by a relatively small collision energy so that a certain part of the collision energy acting on the side frame extension member can be immediately absorbed by the first segment as the first segment is deformed.

The front end of the first segment may be provided with an end flange covering or surrounding a front end edge of the first segment. When the bumper face is brought into striking contact with the front end of the first segment by a relatively small force or energy acting on the front portion of the vehicle, the flange keeps the front end of the first segment out of direct contact with the bumper face. Accordingly, the bumper face is not damaged by the front end of the first segment.

According to a preferred feature, the side frame extension members have a tapered shape or configuration gradually decreasing in height toward the front end thereof.

With this tapered construction, the collision energy is transmitted from the side frame extension member to the corresponding side frame with uniform distribution. In addition, the tapering side frame extension member is highly resistant to bending even though it has a cantilevered construction.

The above and other features and advantages of the present invention will become manifest to those versed in the art upon making reference to the detailed description and accompanying sheets of drawings in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example.

FIG. 1 is a plan view of a side frame structure of a vehicle according to a first embodiment of the present invention, snowing side frame extension members attached to the corresponding side frames;

FIG. 2 is a perspective view of the side frame according to the first embodiment;

FIG. 3 is a front elevational view of the side frame extension member;

FIG. 4 is a is a detailed cross-sectional view showing the side frame extension member attached to the side frame;

FIGS. 5A through 5E are diagrammatical views illustrative of the operation of the side frame extension member taken in conjunction with the operation of an air bag system installed in the vehicle;

FIG. 6 is a detailed cross-sectional view of a side frame structure according to a second embodiment of the present invention, showing a side frame extension member attached to the corresponding side frame;

FIG. 7 is a perspective view of the side frame extension member according to the second embodiment;

FIG. 8 is a fragmentary plan view showing the connection between one side frame and a bumper beam according to the prior art; and

FIG. 9 is an enlarged cross-sectional view taken along line IX - IX of FIG. 8.

The terms "front", "rear", "left", "right", "upper" and "lower" are used herein to refer to directions as viewed from a driver of a vehicle. In the drawings, reference characters "Fr", "Rr", "L" and "R" appearing with arrows mean a front, rear, left and right side, respectively, of a vehicle body.

A side frame structure according to a first preferred embodiment of the present invention will be described below with reference to FIGS. 1 though 5.

The side frame structure according to the first embodiment is used in a vehicle body equipped with an air bag system.

As shown in FIG. 1, the side frame structure includes left and right side frames 2, 2 extending in the longitudinal direction of a vehicle body 1, left and right side frame extension members 3, 3 attached to the respective front ends of the side frames 2, 2, and a bumper face 4 extending in the

direction of the width of the vehicle body and attached to front end portions (distal end portions) of the side frame extension members 3, 3.

The bumper face 4 covers the front end portions of the side frame extension members 3 so as to improve the aesthetic appearance of a front portion of the vehicle. The bumper face 4 is made from a synthetic resin material, for example.

As shown in FIG. 2, each of the side frame extension members 3 is composed of a downwardly open, channel-shaped first segment 11, and an upwardly open, channel-shaped second segment 16. The first and second segments 11 and 16 are combined or assembled together so as to form a tubular member. The first and second members 11, 16 are each formed by bending a steel plate.

Reference numeral 21 designates a back plate attached by spot welding to peripheral flanges 12 on a proximal end of the first segment 11 as at 15.

As shown in FIG. 3, the first and second segments 11, 16 are joined together such that opposite side flanges 13, 13 of the first segment 11 and opposite side flanges 17, 17 of the second segment 16 are joined together by spot welding as at 19 (FIG. 2). The first segment 11 has an end flange 14 extending along a front end edge (distal end edge) thereof. Designated by 23 and 24 are bolt holes through which bolts extend in a manner described later.

As shown in FIG. 4, the side frame extension members 3 (only

one being shown) each have a rear end (a proximal end) connected to the front end of a corresponding one of the side frames 2 by a plurality of bolts 6. The side frame extension member 3 has a tapered shape or configuration gradually decreasing in height toward the front end (distal end). That is, the proximal end of the side frame extension member 3 is greater in height than the distal end. The taper angle of the side frame extension member 3 is preferably in the range of about 3° - 5°.

Each of the side frame extension members 33 is formed by joining together vertically separated two segments, namely, the first segment 11 and the second segment 16, as described above. The second segment 16, which is disposed below the first segment 11, has a front end (distal end) offset or spaced rearwardly from the front end (distal end) of the upper first segment 11 by a distance L. The first segment 11 has an acutely configured front end portion (distal end portion including the end flange 14) slanted at an angle θ of about 60°.

The end flange 14 formed along the front end edge (distal end edge) of the first segment 11 has a function described below.

When the front portion of the vehicle is subjected to a relatively small collision force or energy, the bumper face 4 is forced into abutment with the acutely configured front end portion (distal end portion) of the first segment 11 of at least one of the side extension members 3. In this instance, however,

since the acute front end edge of the first segment 11 is covered or surrounded by the end flange 14, the end flange 14 is brought into contact with the bumper face 4 prior to the acute end edge of the first segment 11. Since the end flange 14 has a relatively large surface area and a certain degree of resiliency, the collision force or energy acting on the bumper face 4 is effectively absorbed by the end flange 14 before the bumper face 4 comes into contact with the acute front end edge of the first segment 11. The bumper face 4 is thus protected against damage. If the first segment 11 is not provided with the end flange 14, the bumper face 4 will be damaged due to direct contact with the acute front end edge of the first segment 11.

Now, description will be given of the operation of the vehicle side frame structure of the first embodiment upon making reference to the relative position between the vehicle and an obstacle shown in FIGS. 5A through 5E.

FIG. 5A shows a condition in which the vehicle is about to collide against an obstacle OB. In this construction, the vehicle is still spaced from the obstacle OB and, hence, the deceleration G of the vehicle is zero.

At the moment of a collision, the vehicle or the front end X of the first segment 11 comes into striking contact with the obstacle OB, as shown in FIG. 5B. In this instance, the deceleration G of the vehicle is very small.

Subsequently, the first segment 11 is plastically deformed

or otherwise crushed by the obstacle OB, as shown in FIG. 5C. In this condition, the deceleration G of the vehicle is small because the energy of collision is absorbed as the first segment 11 is plastically deformed.

Then, the front end Y of the second segment 16 comes into striking contact with the obstacle OB, as shown in FIG. 5D. In this instance, since both segments 11 and 16 are in collision with the obstacle OB, the deceleration G of the vehicle changes to a greater extent than as experienced before in the conditions shown in FIGS. 5A - 5C (the deceleration G of the vehicle in the condition of FIG. 5D is an intermediate).

Since there is distinguishable difference in quantity between a collision force or energy required to cause plastic deformation of only the first segment 11, and a collision force or energy required to cause plastic deformation of both segments 11, 16, a great change in quantity of the deceleration G (corresponding to a great collision energy) caused at the moment shown in FIG. 5D is detected by the air bag system (not shown) to inflate an air bag AB contained in a pad of the steering wheel ST.

Thereafter, the first and second segments 11, 16 concurrently undergo plastic deformation, thereby jointly absorbing the collision energy, as shown in FIG. 5E. In this condition, the deceleration G of the vehicle is large.

The collision energy acting on the side frame extension member 3 is transmitted quickly and uniformly to the

corresponding front end of the side frame 2 and thereafter absorbed by the vehicle body.

FIGS. 6 and 7 show a side frame structure according to a second embodiment of the present invention. These parts which are like or corresponding to those of the first embodiment described above are designated by the corresponding reference numerals, and their description will not be repeated.

FIG. 6, corresponding to FIG. 4, is a view showing the connection or joining between the side frames and the side frame extension members according to the second embodiment.

As shown in FIG. 6, the side frame extension members 3 (only one shown) of the second embodiment are adapted for use in a vehicle not equipped with an air bag system and, for this purpose, they are characterized in that the second segment 16 has a front end (distal end) substantially aligned with the front end (distal end) of the first segment 11 in the vertical direction of the vehicle body 1.

As shown in FIG. 7, the second segment 16 has an end flange 18 extending along each of opposite vertical side edges of the front end (distal end) of the second segment 16.

Since the first and second segments 11, 16 have substantially the same length, they are concurrently engaged in absorbing the collision energy from the initial stage of collision. Accordingly, the side frame extension members 3 of the second segment can absorb a greater collision energy than those of the first embodiment.

It will be appreciated from the foregoing description that the side frame extension members 3 are adaptable to various different types of vehicles by simply changing the position of the front ends of the second segments 16 relative to the front ends of the first segments 11 in view of the usage or application of the side frame extension members 3.

Since the first segment 11 can be used in common regardless of the application of the side frame extension members 3, an enhanced effect of mass production and an easy parts control system are available, which will provide a considerable reduction in manufacturing cost of the side frame extension members 3.

Furthermore, the side frame extension members 3 are designed to plastically deform in a crash or collision, absorbing a certain amount of collision energy and lessening the impact on the vehicle body 1. In the case where a crash is not severe and the energy of the crash can be fully absorbed by the side frame extension members 3, the vehicle can be repaired by simply replacing the deformed or crashed side frame extension members 3.

In the first and second embodiments described above, the side frame extension members 3 are attached to the front portion of the vehicle body 1. The present invention should by no means be limited to the illustrated embodiments but may include another form of application in which the side frame extension members are attached to a rear portion of the vehicle

body 1. In addition, the vertical position of the first and second segments 11, 16 can be reversed.

It will thus be seen that the present invention, at least in its preferred forms, provides a side frame structure for a vehicle, which is simple in construction but capable of absorbing a certain amount of collision energy, and is capable of setting, with sufficient reliability, an adequate magnitude of collision energy to be detected by an air bag system for activation of the same, even when the vehicle is equipped with the air bag system; and furthermore provides a side frame extension member for a vehicle, which can be manufactured with high productivity and can facilitate the parts control operation, regardless of whether the vehicle is equipped with an air bag system.

CLAIMS

1. A side frame structure for a vehicle including left and right side frames extending in the longitudinal direction of a vehicle body, left and right side frame extension members attached to the respective front ends of said side frames, and a bumper face extending in the direction of the width of said vehicle body so as to cover distal end portions of said side frame extension members, characterized in that said side frame extension members are each composed of a tubular member formed by a first segment and a second segment joined together one above the other.

2. The side frame structure of claim 1, wherein said second segment has a distal end spaced rearwardly from a distal end of said first segment.

3. The side frame structure of claim 1, wherein said second segment has a distal end substantially coinciding in position with a distal end of said first segment.

4. The side frame structure of any of claims 1 to 3, wherein said first segment has a distal end portion slanted at an acute angle.

5. The side frame structure of any of the preceding claims, wherein said first segment has a flange at a distal end thereof.

6. The side frame structure of claims 3 and 5, wherein said second segment has a pair of left and right side flanges at a distal end thereof.

7. The side frame structure of any of the preceding claims, wherein said side frame extension members have a tapered configuration with a height smaller at a distal end thereof than at a proximal end thereof.

The Patent Office

17

Application No: GB 9618266.2 **Examiner:** Karl Whitfield
Claims searched: 1 to 7 **Date of search:** 28 October 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7B BCM, BSEB, BSES

Int Cl (Ed.6): B60R 19/24, 19/26, 19/34, B62D 21/15

Other: Online database: Derwent World Patents Index accessed via Questel

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0546352 A1	(TOYOTA) see especially figure 11A	1 & 3
A	GB 2186240 A	(FORD) see especially figure 2	
A	GB 1228088	(GENERAL MOTORS) see especially figure 2	
A	US 5080410	(STEWART et al.) whole document	
A	US 4909565	(HARASAKI et al.) see especially figure 3	

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